

TPACTOOLS

DIGITAL READOUTS

Operation Manual

(Version V1.2)

Dear Users:

Thank you for purchasing multifunction series digital readouts. Digital readouts are used in a wide variety of application. These include machine tools, in feed axes, measuring and inspection equipment, EDM, dividing apparatuses, setting tools, and measuring stations for production control. In order to meet the requirements of these applications, many encoders can be connected to the digital readouts. Read all the instructions in the manual carefully before used and strictly follow them. Keep the manual for future references.

Safety attention:

- To prevent electric shock or fire, moisture or directly sprayed cooling liquid must be avoid. In case of any smoke or peculiar smell from the digital readout, please unplug the power plug immediately, otherwise, fire or electric shock may be caused. In such a case, do not try to repair it, please contact the Company or distributors.
- Digital readout is a precise measuring device used with an optical Linear Scale. When it is in use, if the connection between the Linear Scale and the digital readout is broken or damaged externally, incorrect measuring values may be resulted. Therefore, the user should be careful.
- Do not try to repair or modify the digital readout, otherwise, failure, fault or injury may occur. In case of any abnormal condition, please contact the Company or distributor.
- If the optical Linear Scale used with the digital readout is damaged, do not use a Linear Scale of other brand. Because the performance, specification and connection of the products of different and can not be connected without the instruction of specialized technical personnel, otherwise, trouble will be caused to the digital readout.

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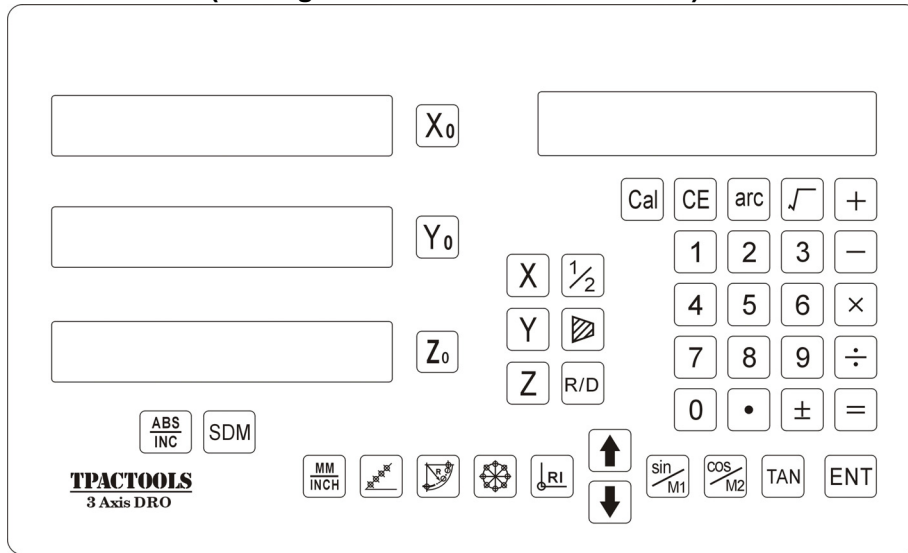
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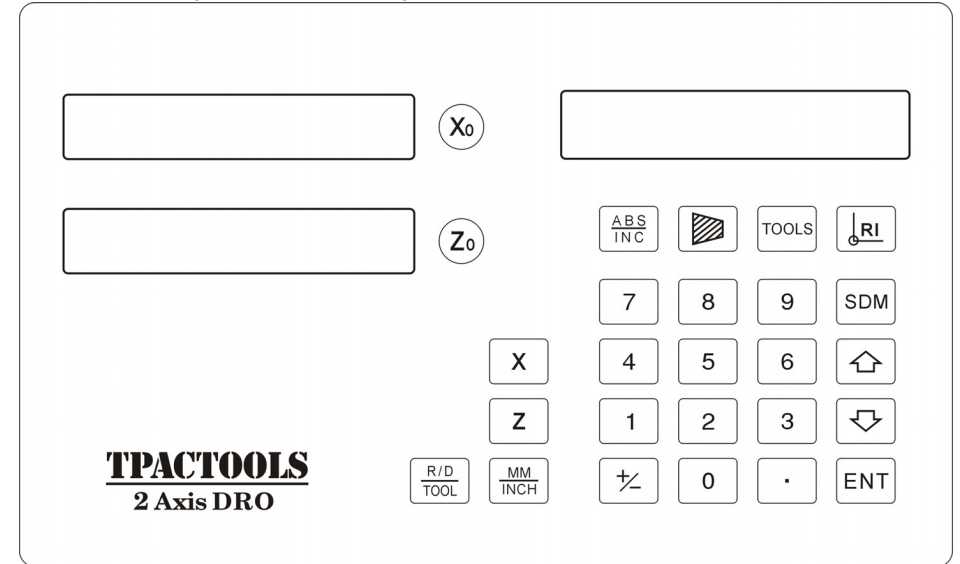
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Illustration of Panel and keyboard

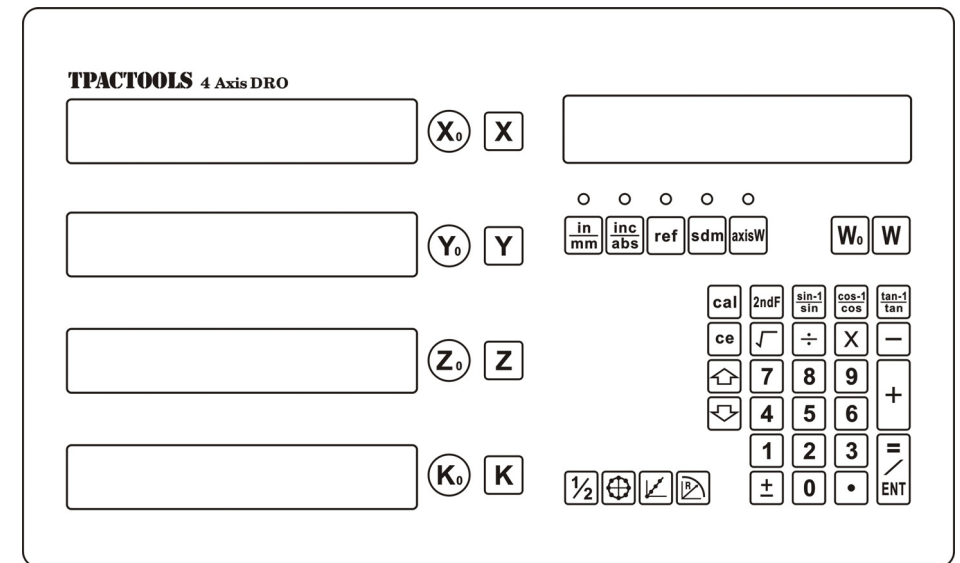
3 Axis DRO (Milling Machine and Lathe machine)



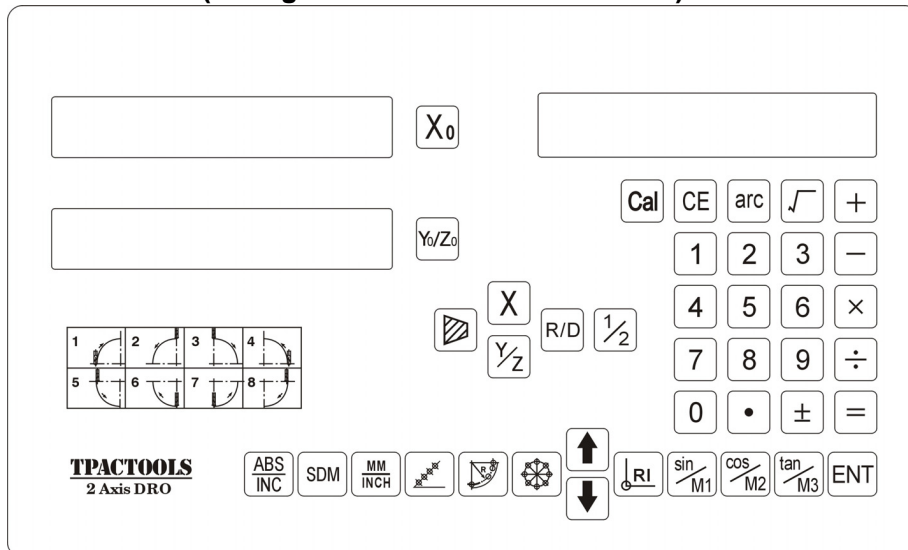
2 Axis DRO (Lathe machine)



4 Axis DRO (Lathe machine)








































2 Axis DRO(Milling Machine and Lathe machine)



Caption of the keyboard

Keyboard Description

X Y Z K W	Keys for axis selection
X ₀ Y ₀ Z ₀ K ₀ W ₀	Zero select axis
	Enter +/- sign
	Enter decimal point
         	Entry keys for numbers
    	Operation key (in Calculation function key)
	Enter or quit calculating state
CE	Cancel incorrect operation
ARC	Calculate inverse trigonometric
	Square root
	Confirm operation
	Toggles between inch and millimeter units.
	Press when ready to identify a reference mark.
	Function keys for 200 sub datum
	ARC cutting function
	holes displayed equally on a circle
	holes displayed equally on a line
	Calculate trigonometric or Slope Processing function key
	Calculate trigonometric or rectangular inner chamber processing function key

	Calculate trigonometric or the tool diameter compensation function key
	Toggle between ABS/INC coordinate
 	Stroll up or down to select
	Taper measured function key
	Tool library call key
	Opens the tool table.(lathe)
	Half a display value of an axis
	Non Linear Error Compensation function keys
R/D	R/D function
RI	Press when ready to identify a reference mark.

3. Parameters settings

3.1 Parameters setup routine entrance

Press or to enter initial system and self-check after DRO powers on in 1 second, then Parameters settings display in the Parameters window. press to select the item you want to change.

If you want to quit initial setting, press until “Quit” appears in message window and press . You can also press to quit initial setting.

3.2.1 Setting the type of the DRO.

The type of the DRO will be display on the right window. then press the key to select the correct type. the following system item will be set:

“MILL-3” means the DRO type is 3-axis milling machine table;

“MILL-2” means the DRO type is 2-axis milling machine table;

“LATHE-2” means the DRO type is 2-axis lathe table;

“LATHE-3” means the DRO type is 3-axis lathe table;



3.2.2 Signal Interface Type

Message window displays “SEL AXIS” which indicates the step is to set up the Sensor type (Linear or Rotary). Press to change the signal mode for X axis; Press to change the signal mode for Y axis and Press to change the signal mode for Z axis; Example X axis as follow:

Press to scroll through the Rotary encode type, the Linear encode type, the Rotary radius type.

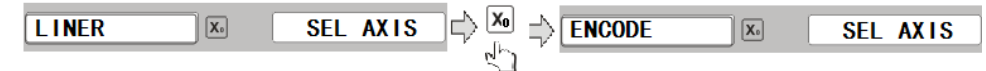
The right window displays the Signal type.

“LInER” means the Signal type is linear encode type ;

“EnCOdE “ means the Signal type is Rotary encode type;

“RdIUS” means the Signal type is Rotary radius type ;

Example: currently in the linear encode type, to toggle to the Rotary encode type;



3.2.3 Restore Factory Settings:

Clear all data except DRO type. DRO will load default setup for parameter. After loading default setup, user must search RI once to enable resuming ABS datum function; otherwise to resume the datum by RI is unable;

Message window displays “ ALL CLR”, press and message windows

display “PASSWORD” indicating the operator to input password; Press 2000 +

in turn to load default value;



3.2.4 Shrinkage Ratio enable or disable.

Message window displays “ SRK OFF” to disable Shrinkage rate function.

Press to enable Shrinkage rate function in Message window displays “ SRK ON”:



3.2.5 Setting Compensation Type

Message window displays“ SEL COMP” which indicates the step is to select the compensation type. Press to change the compensation type for X axis; Press to change the compensation type for Y axis and Press to change the compensation type for Z axis; Example for X axis:

Press to scroll through the not compensation type, the Linear compensation type, the non-linear compensation type.

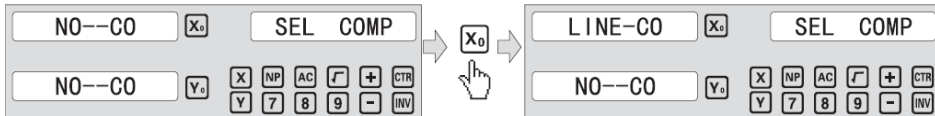
Parameters settings

“no-CO” means the compensation type is not compensation type;

“LInE-CO” means the compensation type is linear compensation type.

“non-LInE” means the compensation type is non-linear linear compensation type;

Example for X axis: currently in the not compensation type, to toggle to the linear compensation type;



3.2.6 Setting RI mode

Message window displays “REF_R” or “REF RAB” which indicates the step is to RI

Mode. Press **ENT** to change the RI mode.

“REF_R” means the RI mode is wave of single R;

“REF_RAB” means the RI mode is wave of A B R with AND gate;



3.2.7 Setting Linearity Compensation.

Message window displays “LIN COMP” which indicates the step is to Linearity Compensation. Compensate the linear error to make display value equals to standard value.

The calculation of compensation rectifying coefficient:

$$(\text{Standard value} - \text{Measurement}) \times 1000.000$$

$$\text{Coefficient} = \frac{\text{Standard value}}{\text{Standard value}}$$

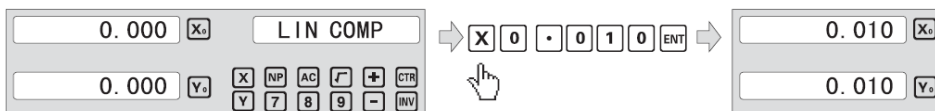
Example for X axis:

Measurement 199.980mm

Standard value 200.000mm

$$\text{Rectifying coefficient} = (200 - 199.980) \times 1000 / 200 = 0.01$$

Input compensation rectifying coefficient 0.01 as follow:



Parameters settings

3.2.8 Setting the Shrinkage Ratio

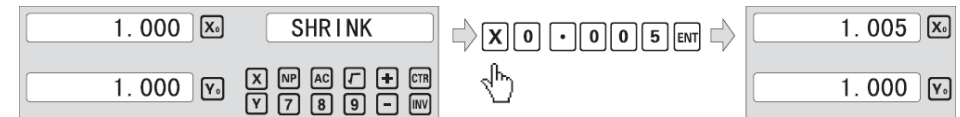
Press **▲** **▼** until “SHRINK” appears in message window;

Dimensions of the finished product

Shrinkage ratio = _____

Dimensions of the working piece

Set the shrinkage ratio 1.005 as follow;



3.2.9 Setting the Resolution

Press **▲** **▼** until “RESOLUTE” appears in message window;

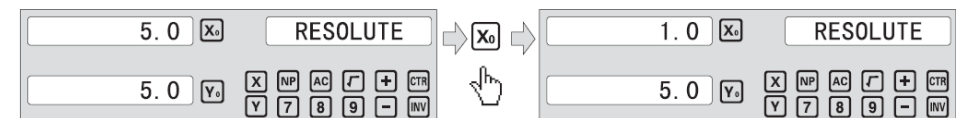
When selecting the LINEAR encode, the resolution will be set as follow:

There are 11 types of resolution:

0.1u;0.2um;0.5um;1um;2um;2.5um;5um;10um;20um;25um;50um;

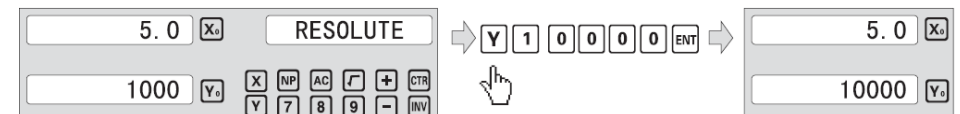
Press **X0** to change the resolution for X axis; Press **Y0** to change the resolution for Y axis; Press **Z0** to change the resolution for Z axis;

Example: Set the resolution 5.0um to 1.0um for X axis:



When selecting the rotary encode, the resolution will be set as follow:

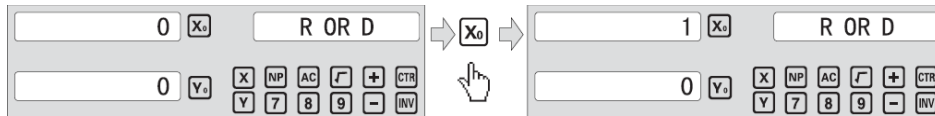
Input the rotary encode parameter value .



3.2.10 Toggle Between R/D Display Mode

Press until “R OR D” appears in message window. X window, Y window, Z window displays ‘0’ or ‘1’ separately.

‘0’ is mode R, which means the display value equals the actual measurement. ‘1’ is mode D where the display value equals the double actual measurement. Press to change the R/D for X axis; Press to change the R/D for Y axis; Press to change the R/D for Z axis; as follow:

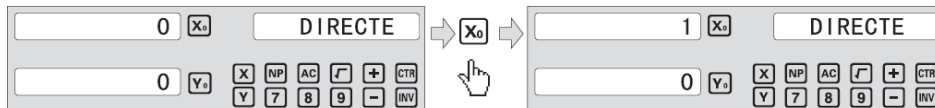


3.2.11 Setting Positive Direction for Counter

Press until “DIRECTE” appears in message window.

Direction ‘0’ means the display value will increase when scale moves from right to left and decrease when scale moves from left to right. Direction ‘1’ means the display value will increase when scale moves from left to right and decrease when scale moves from right to left.

Press to change the Direction for X axis; Press to change the Direction for Y axis; Press to change the Direction for Z axis; as follow:



3.2.12 Setting Z axis Dial

Press until “Z DIAL” appears in message window.

Z axis dial should be set if Z axis is emulated for 2 axis milling and only install linear scale for X,Y axis. Z axis dial means the distance the Z axis travels when screw runs a revolution.

Set the Z axis Dial 2.5mm as follow ;

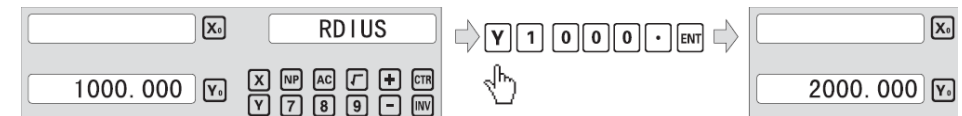


3.2.13 Setting the Rotary Radius of the Work-piece

Press until “RDIUS” appears in message window.

The Rotary radius type is used perimeter to measure angle.

Input the Rotary Radius parameter value 2000mm as follow:



3.2.14 Setting the Angle Display Mode

Press until “ANG DISP” appears in message window.

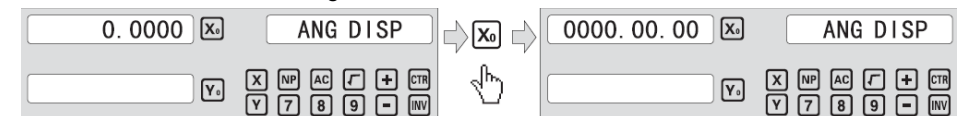
Press to change the angle display mode for X axis; Press to change the angle display mode for Y axis; Press to change the angle display mode for Z axis; Example for X axis:

“0.0000” means the angle mode is Circulating DD;

“0000.0000” means the angle mode is Incremental DD;

“0.00.00” means the angle mode is Circulating DMS;

“0000.00.00” means the angle mode is Incremental DMS;



3.2.15 Setting the Baud rate of RS_232

Press until “BAUDRATE” appears in message window.

Set the Baud rate 115200 as follow ;



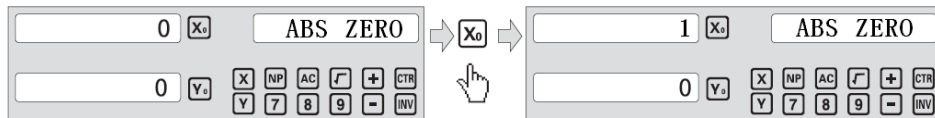
3.2.16 Setting the Absolute Zeroing enable or disable

Press until "ABS_ZERO" appears in the message window.

'0' means operation the ABS zeroing and preset data will be enable in the normal display state.

'1' means operation the ABS zeroing and preset data will be disable in the normal display state.

Press to change the absolute zeroing mode for X axis; Press to change the absolute zeroing mode for Y axis and Press to change the absolute zeroing mode for Z axis; Example for X axis.



3.2.17 Setting the Absolute form the Special Function

Press until "ABS_ASST" appears in message window.

'0' means only special function position value is display in the Special Function operation.

'1' means special function position value + ABS position value is display in the Special Function operation.

Press to change the absolute mode for the Special Function will be set as follow:



3.2.18 Setting the Calculator display Mode

Press until "CTR_MODE" appears in message window.

'0' means the calculator display value at the X window in the display; '1' means the calculator display value at the message window in the display;

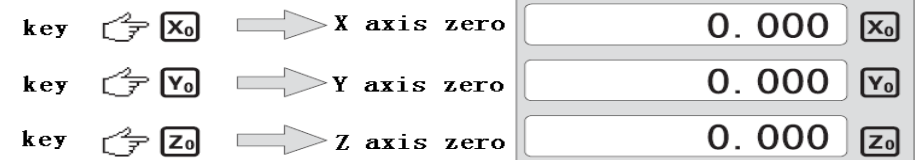
Press to change the calculator display mode will be set as follow:



4. General Operations

4.1 Zeroing

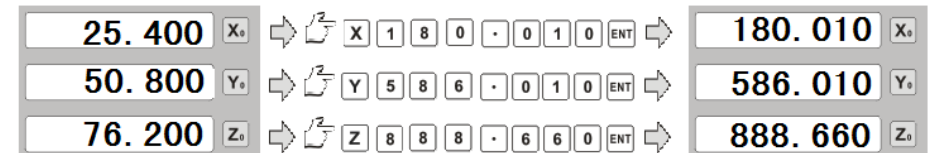
Zero the designated axis in normal display state. Zeroing is used to set the current point as datum point as follow



Press "CE" key + or or will be return to the original data before the reset.

4.2 Preset Data to Designated Axis

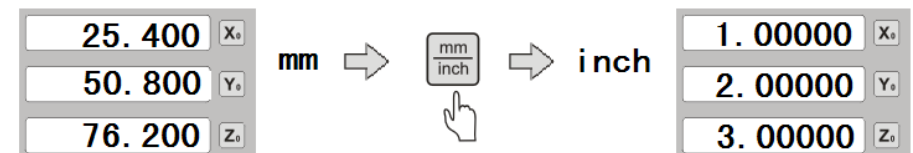
Preset a value to current position for a designated axis in normal display state.



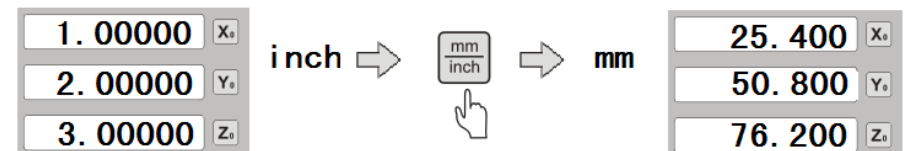
4.3 Toggle Display Unit between inch and mm

Length can be displayed either in "mm"(metric) or "inch" (imperial). Display unit can be toggled between mm and inch.

Example: Display value toggle from mm to inch;



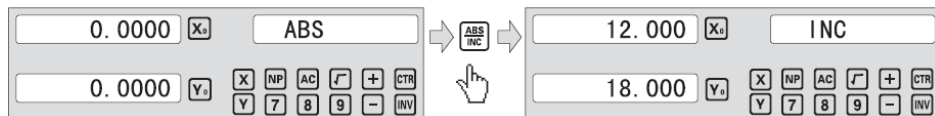
Example: Display value toggle from inch to mm;



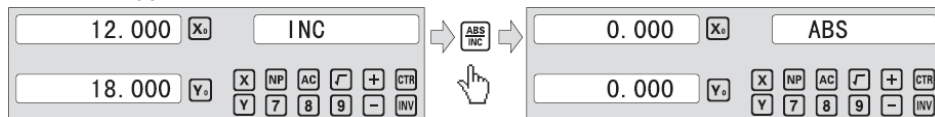
4.4 Absolute/Incremental/200 groups SDM

Function: The DRO has 3 coordinate display modes: the absolute mode (ABS); the incremental mode (INC) and 200 groups Second Data Memory (SDM) with the range of 1 to 200. Zero point of work-piece is set at the origin point of ABS coordinate. The relative distance between datum of ABS and SDM remains unchanged when ABS datum is changed.

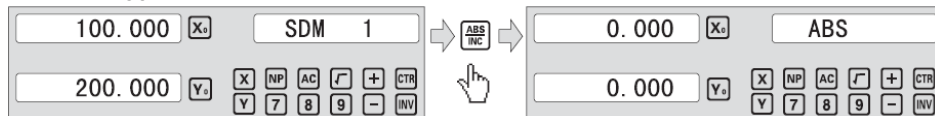
1. Toggle from ABS to INC coordinate



2. Toggle from INC to ABS coordinate



3. Toggle from SMD to ABS coordinate



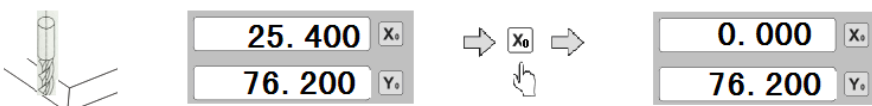
4.5 1/2 Function

Function: Set the center of work-piece as datum by halving the displayed value.

Example: Set the center of rectangle as datum as the right figure.

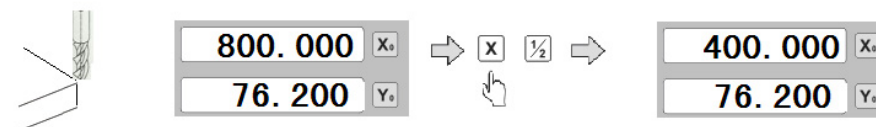
Steps:

1. Touch one side of the work-piece with the TOOL, then zero the X axis.



2. Take the TOOL to the opposite side of the work-piece and touch it. Then press

X + $\frac{1}{2}$ in turn to value the X axis display value.



3. Move the machine table until "0.000" is display in X axis window. The position is the work-piece's center.

4.6 Clear All SDM datum

In ABS mode, to continuously press ***** ten times will cause to clear all the datum for 200 sets SDM. Message window displays "SDM CLR".

4.7 Sleeping Mode

In not ABS Mode, pressing the key **REF** can turn off all the display and the DRO accessing to the Sleeping Mode, then pressing this key again will cause the DRO back to the working Mode. In the Sleeping Mode the DRO is still in working state and actually records the TOOL movement.

Example: In not ABS Mode, to access the sleeping Mode by pressing the key **REF**.

In Sleeping Mode, pressing the key **REF** to quit the sleeping Mode.

4.8 Power Interruption Memory

The memory is used to store the settings of the DRO and machine reference values when power is turn off.

4.9 Search the Absolute Reference Point of Scale

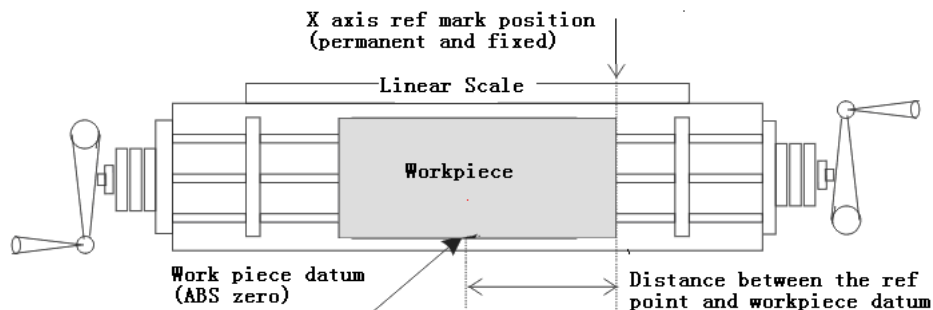
During the daily machining process, It is very common that the machining cannot be completed within one work shift, and hence the DRO have to be switched off after work, or power failure happen during the machining process which is leading to lost of the work-piece datum (work-piece zero position), the re-establishment of work-piece datum using edge finder or other method is inevitably induce higher machining in accuracy because it is not possible to re-establish the work-piece datum exactly at the previous position. To allow the recovery of work-piece datum very accurately and no need to re-establish the work-piece datum using edge finder or other methods, every Linear scale have a ref point location which is equipped with ref position to provide datum point memory function.

The working principle of the ref datum memory function are as follows.

Since the ref point of Linear scale is permanent and fixed, it will never change or disappear when the DRO system is switched off. Therefore, we simply need to store the distance between the ref point and the work-piece datum (zero position) in NON-Volatile memory. Then in case of the power failure or DRO being switched off, we can recover the work-piece datum (zero position) by presetting the display zero position as the stored distance from the ref point.

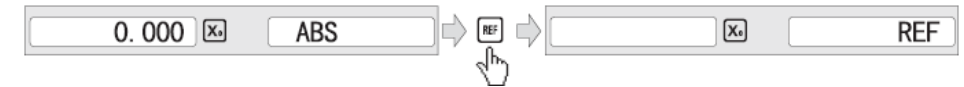
An absolute datum should be set when a work-piece is machined. There are three mode operation (REF、AB、LEF_AB):

Example: to store the X axis work datum.



Example for REF mode :

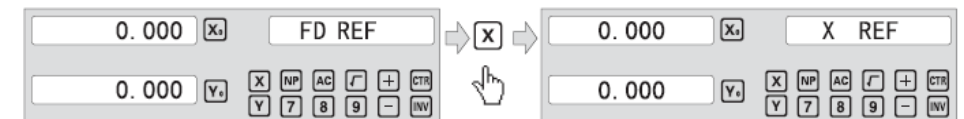
Step 1 DRO is set in ABS coordinate. Press **REF**, then the message window display "REF".



Step 2 Message window displays "REF", Press **ENT** until "FD_REF" appears in message window.



Step 3 Select the axis which need search RI. For instance : select X axis, then press **X**. "X_REF" is displayed in message window, and X axis window flashes.



Step 4 Move the machine table. The buzzer sounds when RI is searched, then X window stops flashing and displays the value of the current position. the DRO returns normal display state. Then message window displays "FIND_X".

Example for AB mode :

Step 1.DRO is set in ABS coordinate. Press **REF**, then the message window display "REF".



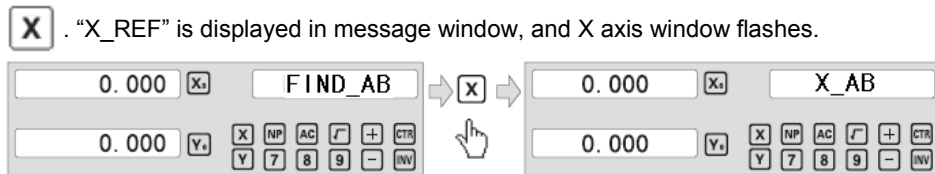
Step 2. Press **▲** **▼**, then the message window display "AB".



Step 3. Message window displays "AB", Press **ENT** until "FIND_AB" appears in message window.



Step 4 Select the axis which need search RI. For instance : select X axis, then press



Step 5 Move the machine table .The buzzer sounds when RI is searched, displays the value of the current position for the absolute datum zero. The DRO returns normal display state. Then message window displays “FIND_AB”.

Example for LEF_AB mode :

Step 1 DRO is set in ABS coordinate. Press **REF**, then the message window display “REF”.



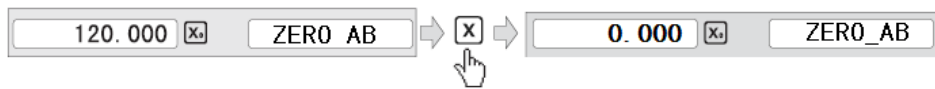
Step 2 Press **▲ ▼**, then the message window display “AB”.



Step 3 Message window displays “LEF_AB”, Press **ENT** until “ZERO_AB” appears in message window.



Step 4 Move the machine table to be set zero position point, then press **X**, X axis will be zeroing. The current position for the absolute datum reset to zero. The DRO returns normal display state.



NOTE: Linear range without reference point location of the user

4.10 Non Linear Error Compensation

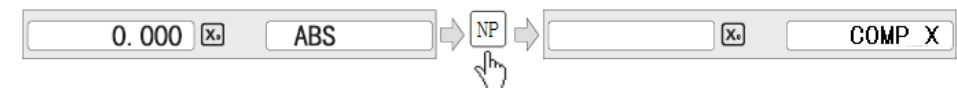
First compensation Type (Linear or Non-Linear) in parameter setting must be set Non-Linear. Linear scale have a ref point. Location and find to the Absolute Reference Point will be enable.

Default Non-Linear compensation : 50.

Example for Y axis:

Step 1 Search the Absolute Reference Point of Scale;

Step 2 Press **CLS**, then the message window display “COMP X”.



Step 3 Press **▲ ▼**, then the message window display “COMP Y”



Step 4 Press **ENT**, then the message window display “NUMBER”.

Then input the compensation parameter NUMBER.



Step 5 Press **▲ ▼**, then message window displays “Y-MSN-1” which indicates the step is to Non Linear Error Compensation.



Step 6 Input compensation value .

X window display the value of the measurement value.

Y window display the value of the standard value.

Example for the first compensation point:

Measurement value :68.288mm. Standard value: 68.200mm



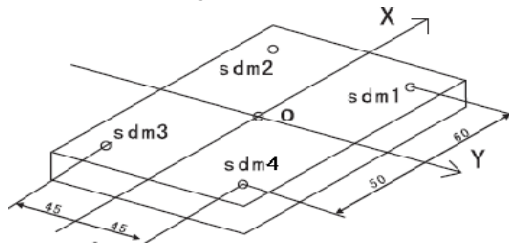
Step 7 After input all parameter, the DRO automatically exit.

5. 200 Groups SDM coordinate

The DRO has three display modes: the absolute mode (ABS). The incremental mode (INC) and the 200 groups second data memory (SDM 1 – SDM200). ABS datum of the work-piece is set at the beginning and the 200 groups SDM is set relative to ABS coordinate.

ABS Mode, INC Mode and SDM Mode are specially designed to provide much more convenience features to the operator to cope with the batch machining of relative works and the machining of the work-piece machining dimensions from more than one datum.

Example: The ABS datum is the center point O, the point sdm1, sdm2, sdm3, sdm4 needed processing are set as datum of SDM 1 –SDM 4.



Two ways to set SDM coordinate:

- 1、 Zeroing at the Current Point
- 2、 Preset datum of SDM coordinate

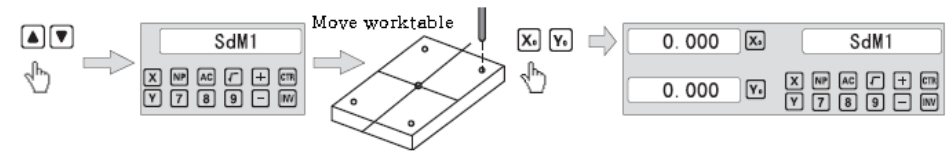
5.1 Zeroing at the Current Point

At first set the center point of the work-piece as the origin of the ABS, then align the TOOL with point sdm1,sdm2,sdm3,sdm4 by moving the machine table and zero them. It is the position to process where the “0.000” appears in X window, Y window by moving the machine table whether in ABS or in SDM coordinate.

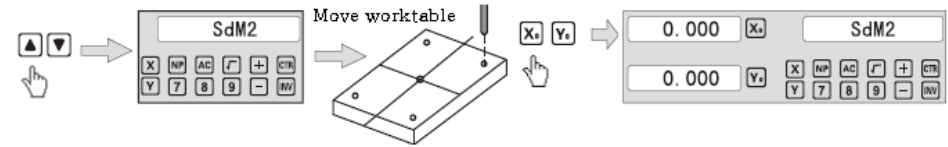
Steps:

Step 1 Move worktable to place the TOOL at the center of the work-piece point O as the datum of ABS. Then zero X axis and Y axis in SDM 1 ; Zero X axis and Y axis in SDM 2 ; Zero X axis and Y axis in SDM 3 ; Zero X axis and Y axis in SDM 4.

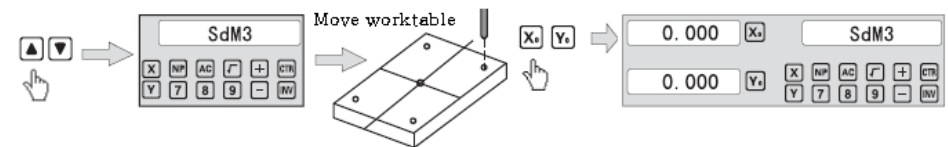
Set the point sdm1 as the datum of SDM 1. Move the machine worktable to x = 60.000, y = 45.000. Then press **X₀** **Y₀**.



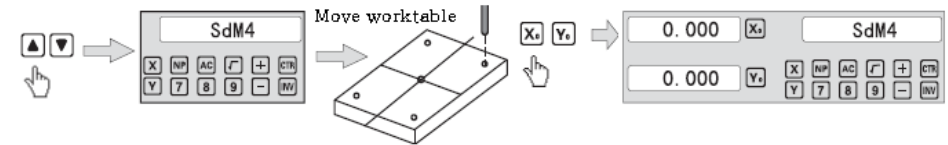
Step 2 Set the point sdm1 as the datum of SDM 2. Move the machine worktable to x = 60.000, y = -45.000. Then press **X₀** **Y₀**.



Step 3 Set the point sdm1 as the datum of SDM 3. Move the machine worktable to x = -60.000, y = -45.000. Then press **X₀** **Y₀**.



Step 4 Set the point sdm1 as the datum of SDM 4. Move the machine worktable to x = -60.000, y = 45.000. Then press **X₀** **Y₀**.





5.2 Preset datum of SDM coordinate



There are the same sample as Method 1. First Move the worktable to place the TOOL exactly at the origin of ABS, secondly Enter the ABS Mode as follow.

Steps:



Step 1 Move worktable to place the TOOL at the center of the work-piece point O as the datum of ABS. Then zero X axis and Y axis in SDM 1 ; Zero X axis and Y axis in SDM 2 ; Zero X axis and Y axis in SDM 3 ; Zero X axis and Y axis in SDM 4.

Step 2 Set point sdm1 as the datum of SDM 1. Press  , then the message window display "SDM 1". Input x = 60.000, y = 45.000.





Step 3 Set point sdm1 as the datum of SDM 2. Press  , then the message window display "SDM 2". Input x = 60.000, y = -45.000.



Step 4 Set point sdm1 as the datum of SDM 3. Press  , then the message window display "SDM 3". Input x = -60.000, y = -45.000.



Step 5 Set point sdm1 as the datum of SDM 4. Press  , then the message window display "SDM 4". Input x = -60.000, y = 45.000.

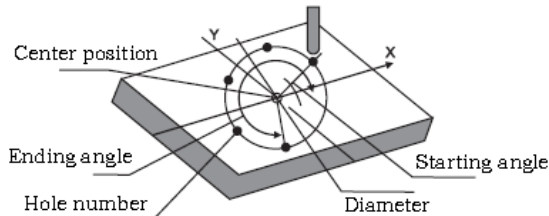


6 Special Function

6.1 Circumference Holes Processing

The Function of PCD Hole positioning on Circumference is used to distribute arc equally, such as boring hole on flange. The right window will show the parameter to be defined when selecting PCD Function. The Parameters to be defined are:

PCD_XY(XZ, YZ)	Select place
CENTER	Center position
DIA	Diameter of circle
NO_HOLE	Hole number
ST ANG	Starting angle
ED ANG	Ending angle

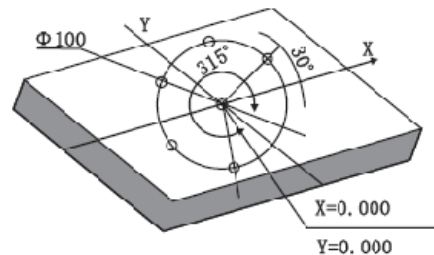


The position of the hole center are calculated automatically after input all parameters.

Press or to choose the hole No. and move the machine table until the "0.000" appears in X window, Y window, Z window. It is the position to process a table.

Example for the XY place: Machine hole on circumference as the figure

PCD_XY(YZ, XZ)	XY
CENTER	X = 0.000, Y = 0.000
DIA	100.000
NO_HOLE	5
ST ANG	30.000
ED ANG	315.000



Steps:

Step 1 Set display unit to metric in normal state; Move the machine table until the machine TOOL is aligned with the center of the circle , then zero X axis ,Y axis.

Step 2 Select plane.

Press , then the message window display "PCD_XY" to the

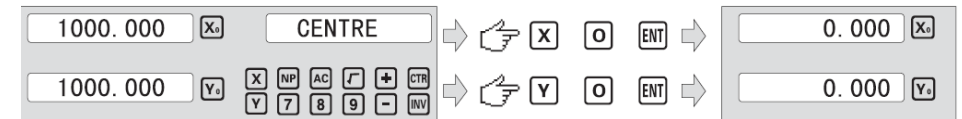
Circumference Holes Processing. Press or to select XY plane.



Step 3 Input center position.

Press , then the message window display "CENTER". X and Y window

displays the formerly preset center position. Input X = 0, Y = 0 as follow.



Step 4 Input diameter.

Press until "DIA" appears in the message window. X window displays the formerly preset diameter. Then input the diameter is 100.000.



Step 5 Input number.

Press until "NO_HOLE" appears in the message window. X window displays the formerly preset number. Then press in turn to input number.



Step 6 Input starting angle.

Press until "ST ANG" appears in the message window. X window displays the formerly preset the starting angle. Then press in turn to input the starting angle.



Step 7 Input ending angle.

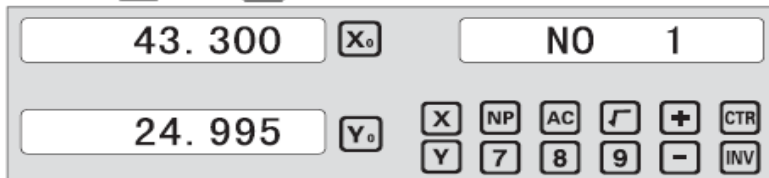
Press until "ED ANG" appears in the message window. X window displays the formerly preset the ending angle. Then press in turn to input the ending angle.

Circumference Holes Processing



Step 8 Press until "NO 1" appears in the message window.

It is the position of the first hole to punch where the "0.000" is displayed in X window and Y window by moving the machine table. After finishing the first hole, press key or key to change holes number.



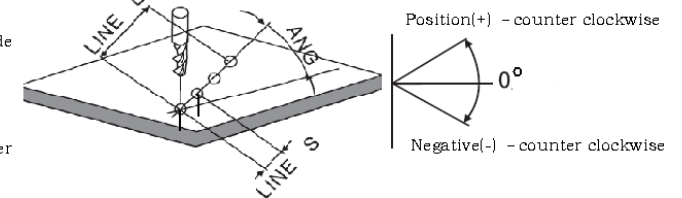
Step 9 After processing all holes, press to return normal display.

Linear Holes Processing

6.2 Linear Holes Processing

There are two modes to carry out the linear drilling: Length mode and Step mode.

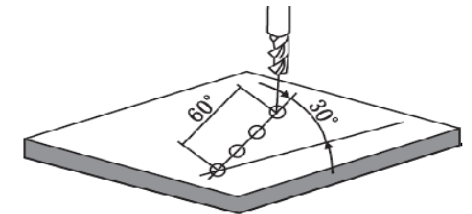
- | | |
|------------|-------------|
| 1. LINE S | Step mode |
| LINE L | Length mode |
| 2. STEP | Step length |
| LENGTH | Line length |
| 3. ANG | Angle |
| 4. NO.HOLE | Hole number |



Linear Holes function can simplify the processing multiple holes whose centers are attributed equally on one line.

Example:

LINE_L	Length mode
LENGTH	60.000
ANG	30.000
NO.HOLE	4



Steps :

Step 1 Select plane.

Press , then the message window display "LINE_XY" to the Linear Holes Processing. Press or to select XY place.



Step 2 Select Linear Holes mode.

Press , then the message window display "LINE_S". Press or to select "LINE_L".



Step 3 Input linear length;

Press , then the message window display "LENGTH".

Linear Holes Processing

X window displays the formerly preset the linear length. Press **6 0** in turn to input the linear length.



Step 4 Input angle

Message window displays “ANG” which indicates the step is to angle. X window displays the formerly preset the angle. Press **3 0** in turn to input the angle.



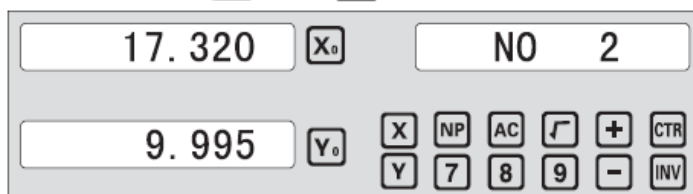
Step 5 Input number;

Message window displays “ANG” which indicates the step is to angle. X window displays the formerly preset the number. Press **4** in turn to input the number.



Step 6 Press **▼** until “NO 1” appears in the message window.

It is the position of the first hole to punch where the “0.000” is displayed in X window and Y window by moving the machine table. After finishing the first hole, press **▲** key or **▼** key to change holes number.



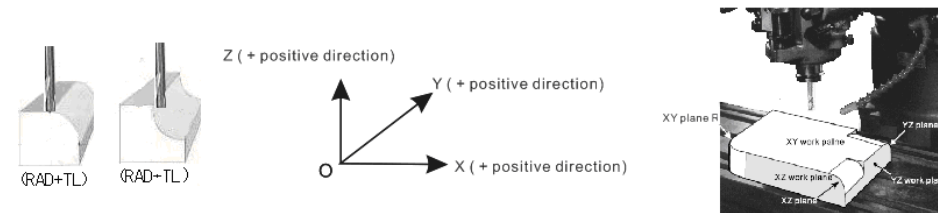
Step 7 After processing all holes, press **RESET** to return normal display.

ARC Processing

6.3 ARC Processing

Two functions are available for the ARC function: the simple ARC Function and the smooth R function. Press **▼** key to enter ARC function, then press **▲** or **▼** for selecting smooth ARC function or Simple ARC Function.

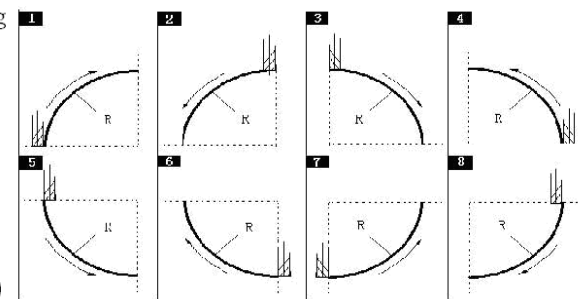
During installation, normally the coordinate of the machine and the direction of X, Y, Z are as per follow. The work plane is shown as the right figure.



Simple ARC Function:

When the smoothness is not highly demanded, the SIMPLE ARC function is normally used for machining arc. In the SIMPLE function there are only eight type of ARC used to machine. The operator just select the type of R and input the parameters of the radius of Arc, MAX CUT and outer arc or inner arc. In general, an arc may be machined by a planar slot TOOL or arc TOOL, the different between them in different work plane as shown as follows.

- | | |
|------------------|---|
| 1. SIMPLE | Simple processing |
| 2. TYPE 1-8 | Mode of the ARC. |
| 3. SEL_XY(XZ,YZ) | Select place |
| 4. RAD | Arc radius |
| 5. TL DIA | Tool diameter |
| 6. MAX CUT | Feed step |
| 7. RAD_TL | Outer arc and inner arc (only for XY place) |



Smooth ARC function:

Provides maximum flexibility in ARC machining, the ARC sector to be machined by the coordinates of ARC. Very flexible, ARC function can machine virtually all kinds of ARC, even the intersected ARC. Relatively a bit complicated to operate, operator need to calculate and enter the coordinates of ARC centre, start angle and end angle.

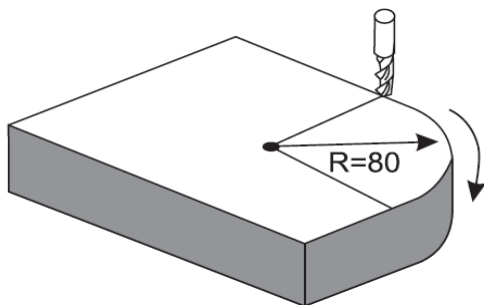
Basic parameter as follow:

- | | |
|--------------------|-------------------------------------|
| 1. SMOOTH | Mode of the Smooth ARC processing; |
| 2. SEL_XY (YZ, XZ) | Select plane; |
| 3. CENTER | Refer to the position of an center. |
| 4. RAD | Radius of the ARC |
| 5. TL_DIA | Diameter of the TOOL |
| 6. MAX_CUT | Feed step |
| 7. ST_ANG | Starting angle |
| 8. ED_ANG | Ending angle |
| 9. RAD+TL | Outer arc. |
| RAD-TL | Inner arc. |

Example 1 for the Simple ARC Processing:


Parameters settings as follow:



SIMPLE	Simple mode
TYPE	3
SEL_XY	XY
RAD	80.000
TL_DIA	6.000
MAX_CUT	0.500
RAD+TL	1



Steps:



Step 1 Select process mode

Press , then the message window display "SIMPLE" to the ARC

Processing. Press  key or  key to select the mode of the simple. The message window display "SIMPLE"






Step 2 Input the type:

Press  until "TYPE" appears in the message window. X-window displays the formerly preset the type. Press  in turn






Step 3 Select plane

Press  until "SEL_XY" appears in the message window. Press  or  to select place to display "SEL_XY";






Step 4 Input radius:

Press  until "RAD" appears in the message window. X window displays the formerly preset the radius of ARC. Press   in turn to input the radius.;







Step 5 Input Diameter of the TOOL

Press  or  until "TL DIA" appears in the message window. X window displays the formerly preset the Diameter of the TOOL. Press  in turn to input the Diameter value;



Step 6 Input Feed step (MAX_CUT);

Press  or  until "MAX_CUT" appears in the message window. X window displays the formerly preset the MAX_CUT. Press   in

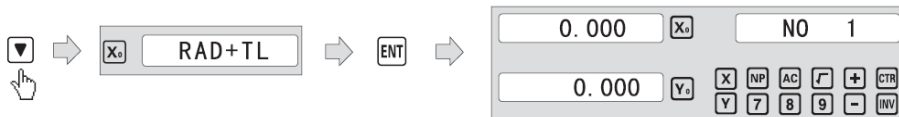
turn to input the MAX_CUT value;



Step 7 Select outer arc or inner arc

Press or until "RAD-TL" appears in the message window. Press

or to select place to display "RAD+TL";



Step 8 After inputting all parameters, press the key for machining.

The DRO will display the position of the first point. Retract the axes until the displays read 0.000, Machine the Arc point by point in accordance with the display. After finishing the position of the first point, press or to change position point.

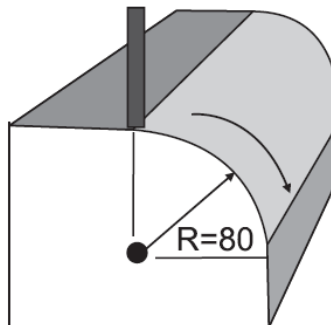


Press to quit R function any time.

Example 2 for the Simple ARC Processing:

Parameters settings as follow:

SIMPLE	Simple mode
TYPE	3
SEL_XY	XZ
RAD	80.000
TL_DIA	6.000
MAX_CUT	0.500



Steps:

Step 1 Press , then the message window display "SIMPLE" to the ARC

Processing. Press or to select the mode of the simple. The message window display "SIMPLE"



Step 2 Input the type:

Press until "TYPE" appears in the message window. X-window displays the formerly preset the type. Press in turn



Step 3 Select place

Press until "SEL_XY" appears in the message window. Press or to select place to display "SEL_XY"



Step 4 Input radius:

Press until "RAD" appears in the message window. X window displays the formerly preset the radius of ARC. Press in turn to input the radius.;



Step 5 Input Diameter of the TOOL

Press or until "TL DIA" appears in the message window. X window

displays the formerly preset the Diameter of the TOOL. Press **6** in turn to input the Diameter value;



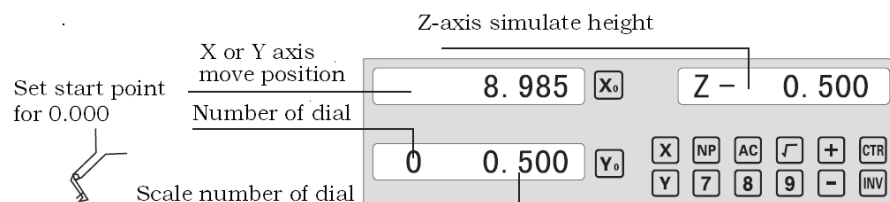
Step 6 Input Feed step (MAX_CUT);

Press **▲** or **▼** until "MAX_CUT" appears in the message window. X window displays the formerly preset the MAX_CUT. Press **0** **.** **5** in turn to input the MAX_CUT value;



Step 7 After inputting all parameters, press the key **ENT** for machining.

For 2-axis milling machine table, It is not installed with Z-axis, please press **▲** or **▼** to simulate position of Z-axis. Press **▲** simulate moving to the former process, and press **▼** simulate moving to the next process point.



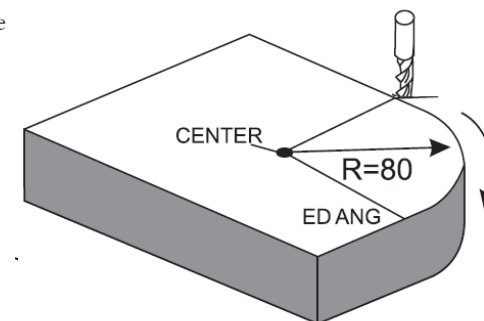
Z-axis simulate height = Number of dial x Z axis Dial + Scale number of dial

Press **ESC** to quit R function any time.

Example 3 for the Smooth ARC function:

Parameters settings as follow:

SMOOTH	Smooth mode
SEL_XY(YZ, XZ)	XY
CENTER	X=0, Y=0
RAD	80.000
TL_DIA	6.000
MAX_CUT	0.500
ST_ANG	0.000
ED_ANG	135.000
RAD+TL	1



Step1 Press **ESC**, then the message window display "SIMPLE" to the ARC

Processing. Press **▲** or **▼** to select the mode of the smooth, The message window display "SMOOTH"; For 3-axis milling machine table without this step. Then press **ENT**.



Step 2 Select plane

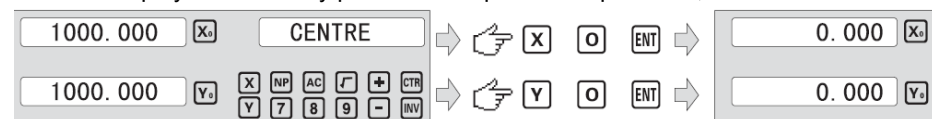
Message window display "SEL_XY" which indicates the select is to place. Press

▲ or **▼** to select place to display "SEL_XY";



Step 3 Input center position.

Press **ENT**, then the message window display "CENTER". X and Y window displays the formerly preset center position. Input X = 0, Y = 0 as follow.



Step 4 Input radius:

Press **ENT** until "RAD" appears in the message window. X window displays the formerly preset the radius of ARC. Press **8** **0** in turn to input the radius.;



Step 5 Input Diameter of the TOOL

Press **▲** or **▼** until "TL DIA" appears in the message window. X window displays the formerly preset the Diameter of the TOOL. Press **6** in turn to input the Diameter value;



Step 6 Input Feed step (MAX_CUT);

Press **▲** or **▼** until "MAX_CUT" appears in the message window. X window displays the formerly preset value. Press **0** **.** **5** to input the MAX_CUT value;



Step 7 Input starting angle.

Press **▼** until "ST ANG" appears in the message window. X window displays the formerly preset the starting angle. Then press **0** in turn to input the starting angle.



Step 8 Input ending angle.

Press **▼** until "ED ANG" appears in the message window. X window displays the formerly preset the ending angle.. Then press **1** **3** **5** in turn to input the ending angle.



Step 9 Select outer arc or inner arc

Press **▲** or **▼** until "RAD-TL" appears in the message window. Press **▲** or **▼** to select place to display "RAD+TL";



Step 10 After inputting all parameters.

The DRO will display the position of the first point. Retract the axes until the displays read 0.000, Machine the Arc point by point in accordance with the display. After finishing the position of the first point, press **▲** or **▼** to change position point.



Press **ESC** to quit ARC function any time.

6.4 Oblique Processing

There are 2 ways available for processing oblique place:

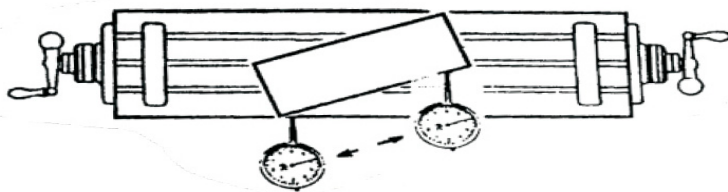
- on the XY plane
- on the YZ, or XZ plane

Only the following parameters need to be inputted:

INCL_XY(XZ,YZ)	Set machine place XY,YZ,Or XZ place.
ANG	The inclination angle of the oblique.
DIA	The TOOL Diameter.
ST_POT	Starting position;
ED_POT	Ending posting;

Example 1 for the Oblique XY place:

When the machining plane is on plane XY as the part shown in Figure, the angle of obliquity of the workpiece should be calibrated before the oblique plane is machined. Therefore, at this point the machining of oblique plane plays the role of calibrating the obliquity.



Procedure for calibrating the obliquity

First place the work-piece on the worktable as per the required angle of obliquity.

- Enter the function of oblique plane
- Select the function of plane X_Y
- Input the angle of obliquity
- Move the worktable until the measuring tool (such as a dial gauge) installed on the milling machine touches the obliquity-calibrating plane, adjust it to zero, and move the worktable for any distance in the direction of X-axis
- Move the worktable in the distance of Y-Axis until the display turns to zero
- Change the angle of the work piece to make the work-piece touch the measuring tool and adjust it to zero.

STEPS:

Step 1 Select plane

Press $\frac{\sin}{M1}$, then the message window display "INCL_XY" to the Oblique Processing. Press Δ or ∇ to select place to display "SEL_XY"; Then press ENT to in next step;

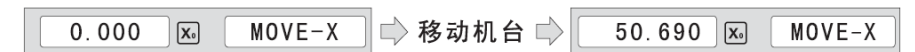


Step 2 Input the angle of obliquity

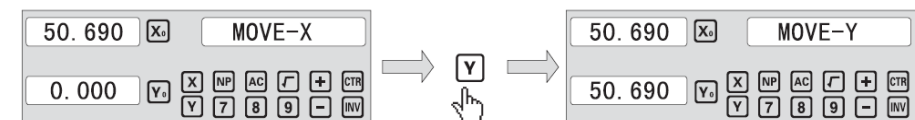
The message window display "ANG", X window displays the formerly preset the angle of obliquity. Press 45 in turn to input the angle of obliquity.



Step 3 Move the work-piece along the X-Axis until the measuring tool touches the work-piece adjust it to zero, and move the worktable for any distance along the X-Axis.



Step 4 Press Y , display the value of Y-Axis. Move the workpiece along the Y-Axis, change the angle of workpiece to make the obliquity-calibrating plane touch the measuring tool until it turns to zero. Move the worktable until Y-Axis is displayed as zero.



Step 5 Press $\frac{\sin}{M1}$ to quit oblique function any time.

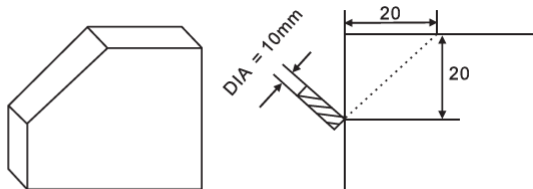
Example 2 for the oblique XZ or YZ place:

When the machining plane is on plane XZ or YZ, the function of TOOL inclination can indicate the operator to machine the oblique plane step by step.

Procedures for using the function of cutter inclination:

When the machining plane is on plane XZ or YZ, first please calibrate the obliquity of the primary spindle nose and set the TOOL:

INCL_XY(XZ,YZ)	INCL_XZ
DIA	10.000
ST_POT	20.000
ED_POT	20.000



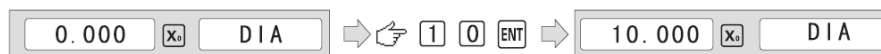
STEPS:

Step 1 Press , then the message window display "INCL_XY" to the oblique Processing. Press or to select place to display "SEL_XZ; Then press to in next step;



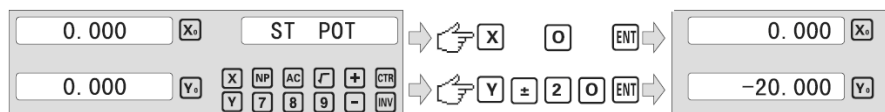
Step 2 Input The TOOL Diameter

The message window display "DIA", X window displays the formerly preset the angle of obliquity. Press in turn to input the TOOL Diameter of obliquity. OK, then press to in next step;



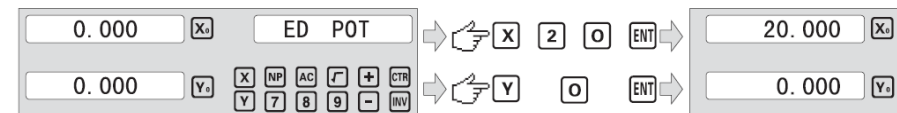
Step 3 Input ST_POT;

The message window display "ST_POT", X and Y window displays the formerly preset the stating position of obliquity. Input X= 0, Y = -20.000. OK, then press to in next step;



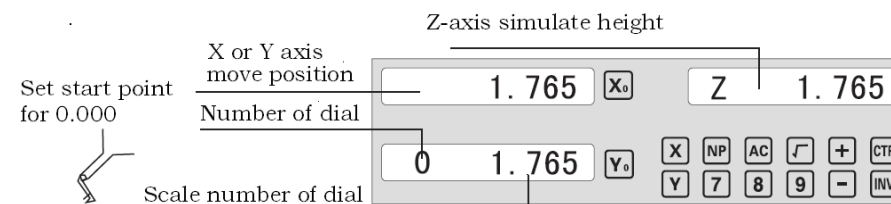
Step 4 Input ED_POT;

The message window display "ED_POT", X and Y window displays the formerly preset the stating position of obliquity. Input X= 20.000, Y = 0.000 .



Step 5 After input all parameter, press the key for machining.

For 2-axis milling machine table, It is not installed with Z-axis, please press or to simulate position of Z-axis. Press simulate moving to the former process, and press simulate moving to the next process point.



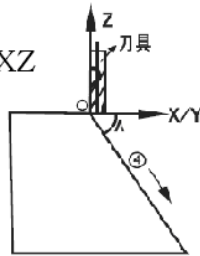
Z-axis simulate height = Number of dial x Z axis Dial + Scale number of dial

Press to quit **oblique** function any time.

6.5 Slope Processing

This function can calculate the position of every processing point automatically in processing slope. Only the following parameters need to be inputted:

XZ, YZ	Set machine place YZ, or XZ
ANG	The inclination angle
Z_STEP	The slope length each time processing



Example 1 for the Slope XZ place;

Step 1 Select plane

Press $\text{TAN}/M3$, then the message window display "XZ" to the slope Processing.

Press \blacktriangle or \blacktriangledown to select place to display "SEL_XY";

Then press ENT to in next step;



Step 2 Input the angle of slope

The message window display "ANG", X window displays the formerly preset the angle of slope. Press 4 5 in turn.



Step 3 Input Z-step

The message window display "Z STEP", X window displays the formerly preset the stating position of slope. Input 0 \cdot 1 in turn.



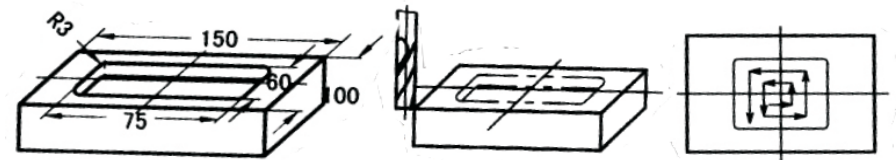
Step 4 Finishing the ALL processing . Press $\text{TAN}/M3$ to quit slope function any time.

6.6 Chambering Processing

1 FLAT_XY: machine place; 2 DIA: diameter of TOOL;

3 CENTER: center of the chambering ; 4, SIZE: size of the chambering ;

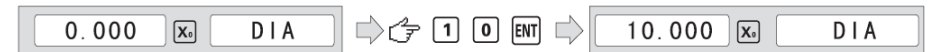
Figure as follow:



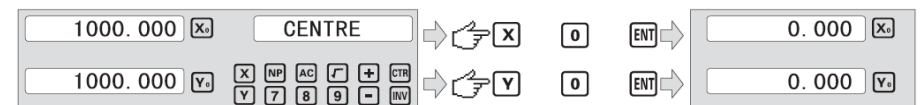
Step 1 Press $\text{COS}/M2$, then the message window display "FLAT_XY" to the Chambering Processing.



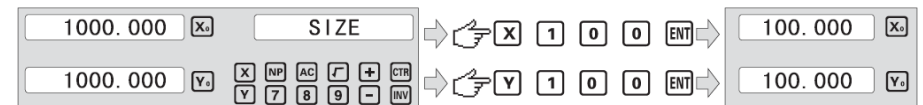
Step 2 Input DIA of the TOOL;



Step 3 Input the center coordinate;



Step 4 Input the size;



Step 5 process Chambering;

Move the machine until the display of the axis is 0, ie, the position of the first point. Machine the first point . Display the next machining point by pressing \blacktriangledown . after the end point of machining, the right window shows OVER. Press \blacktriangle or \blacktriangledown , the system will go to the first position for the next work-piece. Press $\text{COS}/M2$ to quit the Function.

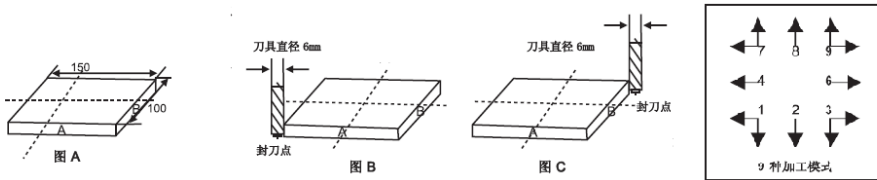
6.7 The Tool Diameter Compensation Function

Without TOOL compensation, the operator has to move the TOOL for an additional distance of the diameter of the TOOL along each side when machining the four 150 and 100 sides of a work-piece to finish machining the whole brim. The digital readouts shall automatically compensate when the TOOL compensation function is enable.

Note: the TOOL compensation is made in the direction of X and Y-axis.

Procedures:

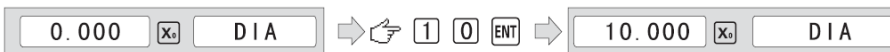
1. Enter the function of compensating the diameter of the TOOL.
2. Select one of the (four) preset machining modes.
3. Input the diameter of the TOOL.
4. Enter machining.



Step1 press to enter the TOOL compensation Function. then the message window display "TYPE". Press .



Step 2 input the diameter of the TOOL; Press in turn..



Step 3 Press to the machining Mode.



Machining of 2 side planes can be done by moving the TOOL until X-Axis is 150.000 and Y-Axis is 100.000. Press the Key to quit the Function.

6.8 Lathe Function

6.8.1 200 sets TOOL Libs

It always needs different TOOL when processing different parts. For convenient operation, the Lathe digital readouts have the function of 200 sets TOOL Libs.

Note: Only when the lathe is equipped with the tool setting block, the 200 sets TOOL Libs can be used.

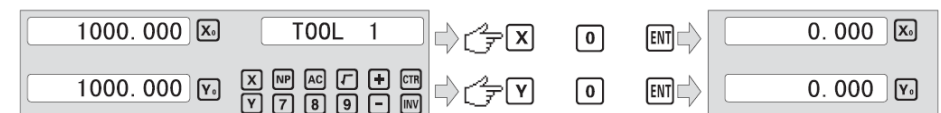
1. Set a datum TOOL. After tool setting, Zero X axis and Z axis, the set zero of absolute coordinate.
2. According to the size of TOOL and datum TOOL, determine the position of TOOL relative to zero of absolute coordinate and datum tool. As Figure 6-1. The relative size of TOOL 2 is as follows X axis 25-30=-5, Z axis 20-10=10.
3. Save the TOOL number and the size into digital readout.
4. The number of TOOL can be input at random, the digital readouts will display the position of tool to absolute coordinate zero. Move lathe until X axis and Z axis both display zero.
5. TOOL Libs can save the 200 sets of the data of tools.
6. The TOOL Libs must be use in the opening state. The 200 sets TOOL Libs can be opened by continuously pressing ten times until the right window flashes TL - OPEN and a mark "↖" display at the left of the right information window. The Mark indicates the operator can setup or revise the 200 sets TOOL Libs. Continuously pressing the key ten times will cause the 200 sets TOOL Libs to be closed and the right window flashes TL - CLOSE and the Mark disappear. When the Mark "↖" disappear the 200 sets TOOL Libs can not be revised.

The operations for TOOL data and call TOOLS is shown as follows.

Step 1 In ABS state, input the data of the 200 sets TOOL Libs. To opening the 200

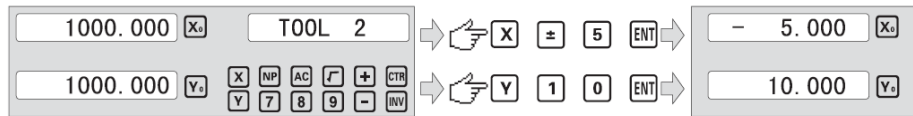
sets TOOL Libs by continuously pressing the key ten time. A Mark "↖" will appear at the left window of the right info window.

Step 2 Press to access the inputting state. Input TOOL 1 data:



Lathe Function

Step 3 Input TOOL 2 data:



Step 4 Press to continue to input the data of next tool. By pressing number and the key **ENT**, the operator can directly input the special tool data. Press **TOOL** to quit.
After TOOL lib is setup. Use the TOOL lib according to the following operations first mount the second tool.

Step 5 To access the using state by press **CALL**. Then press **2** **ENT**.



Step 6 Press **▲** or **▼**. Select the base TOOL. Then press **1** **ENT**.



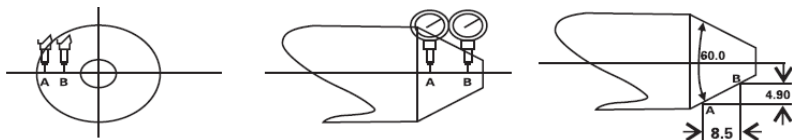
Step 7 Press **CALL** to quit the function;

Note:

- When the base tool is used, the axis can not be zeroed in ABS state.
- When the others are used, the axis can only be zeroed in INC state.

6.8.2 Taper Function

For lathing the work-piece with taper, the taper of the work-piece can be measured in processing;



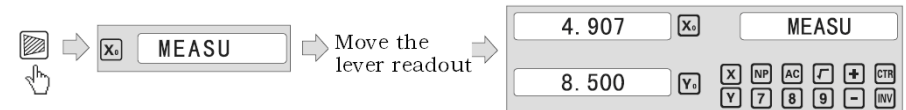
Lathe Function

Operations :

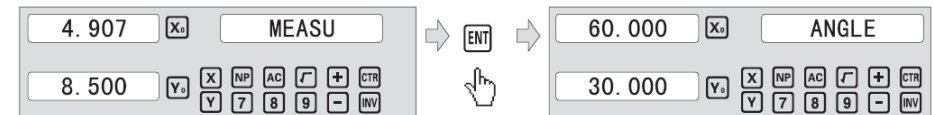
As figure, contact surface A of work-piece with lever readouts and resets the lever readouts point to zero.

Step 1 Press **MEASU**, then the message window display "MEASU" to the Taper

processing. Move the lever readout to the surface B until the lever readouts point as follow;



Step 2 Press **ENT** to calculate .



Step 3 press **MEASU** to quit the function;

6.8.3 R/D Function

For 2 axes and 3 axes Milling Lathe DRO, press R/D key for R/D function.

The display Mode of X axis is switched between Radius and Diameter . When X axis for display of "Diameter", A mark "∅" will appear at the left of the right information window, but when X axis for display of "Radius", the mark "∅"disappear . Only X axis has the function of the diameter / radius transformation.

Note:

For 2 Lathe DRO, press the X key + R/D key for R/D function

7 Calculator

The Calculator not only provides normal mathematical calculations such as +, -, x, /, it also provide trigonometric calculations such as SIN, Arc SIN, COS, Arc COS, TAN, Arc TAN SQRT etc.

The Operations are as same as the commercial calculators, easy to use.

Enter and exit Calculator Function

In normal display state: Press **CTR** to enter calculator function.

In calculator display state: Press **CTR** to exit calculator function.

Transferring the Calculator Results to Selected Zxis.

After calculating is finished, if the Calculator display Mode Set for mode 1, user can:

Press **X₀** to transfer the calculated result to X axis; then the X window will display this value;

Press **Y₀** to transfer the calculated result to Y axis; then the Y window will display this value;

Press **Z₀** to transfer the calculated result to Z axis; then the Z window will display this value;

Transferring the Current Display Value in window to Calculator.

if the Calculator display Mode Set for mode 1, user can:

Press **X** to transfer the display value in X window to calculate;

Press **Y** to transfer the display value in Y window to calculate;

Press **Z** to transfer the display value in Z window to calculate;

8 Appendix

8.1 Troubleshooting:

The following are the preliminary solvents for troubleshooting.

If there is still trouble, please contact out company or agents for help.

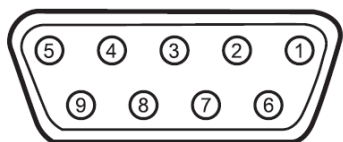
Troubles	Possible reasons	Solvents
No display	1. Power isn't connected 2. Power switch is off. 3. The range of power voltage is not right. 4. The inner power of Linear Scale is short.	1. Check power wire and connect the power 2. Turn on the power switch. 3. The range of voltage is in 80--260V 4. Unplug the connector of linear scale
One axis is not counting	1. Replace the linear scale of the other axis. 2. DRO is in special function	1. If count is normal, the linear scale has trouble; If abnormal, the DRO readouts has trouble. 2. Quit the special function.
Linear scale is not counting	1. Reading head is bad for using range exceeds. 2. Aluminum chips is in reading head of linear scale. 3. The span between the reading head and metal part of linear scale is large. 4. The metal parts of linear scale is damage.	1. Repair the linear scale 2. Repair the linear scale 3. Repair the linear scale 4. Repair the linear scale
Counting is error	1. Shell is poor grounding. 2. Low precision of machine . 3. Speed of machine is too rapid. 4. Precision of linear scale is low. 5. The resolution of DRO readouts and the linear scale is not match. 6. The unit (mm/inch) is not match. 7. Setting the linear compensating is not arrest. 8. Reading head of the linear scale is damaged.	1. Shell is good grounding. 2. Repair the machine. 3. Reduce the speed of machine. 4. Mount the linear scale again. 5. Set the resolution of the DRO again. 6. Cover the unit of display mm/inch. 7. Reset the linear compensation. 8. Repair the linear scale.
The counting of the linear scale is not accurate	1. The mounting of linear scale does not demand the requirement, and the prcision is not adequate. 2. The screw is loosen. 3. Precision of machine is low. 4. The resolution of digital readouts and the linear scale is not match.	1. Mount the linear scale again and level it. 2. Lock all fixing screws. 3. Repair the machine. 4. Reset the resolution of digital readouts.
Sometimes the linear scale is not counting	1. The small car and steel ball is separated. 2. The glass of reading head is wearied. 3. The glass of reading head of the linear scale has dirt. 4. The elasticity of the linear wire is not adequate.	1. Repair the linear scale 2. Repair the linear scale 3. Repair the linear scale. 4. Repair the linear scale.

8.2 Specifications of Digital Readout.

- 1) Supply Voltage range: AC 86 V ~ 240 V; 50 ~ 60 Hz
- 2) Power consumption: 15VA
- 3) Operating temperature: 0 -- 50
- 4) Storage temperature: - 30 -- 70
- 5) Relative humidity: < 90 % (25)
- 6) Max Coordinate number: 3
- 7) Readout allowable input signal: TTL square wave
- 8) Allowable input signal frequency: < 5 M Hz
- 9) Max resolution of digital display length: 0.1 μ m
- 10) Max resolution of digital display angle: 0.0001 / PULSE

8.3 Examples of character output at the data interface

- 1、X,Y,Z Axis



N0	external signals
1	A-
2	0V
3	B-
4	PE
5	R-
6	A+
7	+5V
8	B+
9	R+